

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Original) A substrate bonding device for fabricating a liquid crystal display (LCD)

panel, comprising: a base frame:

a lower chamber unit mounted to the base frame, wherein the lower chamber unit defines a lower interior space and includes an upper surface;

an upper chamber unit arranged over the lower chamber unit, wherein the upper chamber unit defines an upper interior space, includes a lower surface, and is joinable to the lower chamber unit;

chamber moving means for raising and lowering the upper chamber unit;

an upper stage arranged within the upper interior space for securing a first substrate;

a lower stage arranged within the lower interior space for securing a second substrate;

alignment cameras provided to at least one of the upper and lower chamber units for verifying an alignment state of a plurality alignment marks formed on the first and second substrates; and

alignment means arranged at side portions of the lower chamber unit for adjusting an alignment between the first and second substrates.

2. (Original) The substrate bonding device as claimed in claim 1, wherein the upper chamber unit includes:

an upper base exposed to an external environment; and

an upper chamber plate attached to the lower surface at a periphery of the upper base.

3. (Original) The device as claimed in claim 2, wherein the upper chamber plate is provided as a rectangular rim defining the upper interior space within which the upper stage is arranged.
4. (Original) The device as claimed in claim 3, wherein the upper stage is fixed to the upper base.
5. (Original) The substrate bonding device as claimed in claim 1, wherein the lower chamber unit includes:
 - a lower base fixed to the base frame; and
 - a lower chamber plate arranged above the upper surface at a periphery of the lower base.
6. (Original) The device as claimed in claim 5, wherein the lower chamber plate is provided as a rectangular rim defining the lower interior space within which the lower stage is arranged.
7. (Original) The device as claimed in claim 5, wherein the lower chamber plate is moveable in lateral directions with respect to the lower base.
8. (Original) The device as claimed in claim 5, wherein the lower stage is fixed to the lower base.
9. (Currently Amended) The substrate bonding device as claimed in claim ~~[[1]]~~ 5, wherein the alignment means includes:

a plurality of cams rotatably provided to selectively contact and push peripheral portions of the lower chamber plate;

a plurality of shafts connected to corresponding ones of the plurality of cams; and

a plurality of motors fixed to the lower base and connected to corresponding ones of the plurality of cams for rotating the plurality of cams via corresponding ones of the plurality of shafts.

10. (Original) The substrate bonding device as claimed in claim 9, wherein each of the plurality of shafts are eccentrically connected to corresponding ones of the plurality cams.

11. (Original) The substrate bonding device as claimed in claim 9, wherein each of the plurality of motors include a step motor.

12. (Original) The substrate bonding device as claimed in claim 9, wherein

the lower chamber unit includes a first pair of opposing sides and a second pair of opposing sides, wherein a length of the first pair of opposing sides is greater than a length of the second pair of opposing sides;

two cams are arranged proximate each side of the first pair of opposing sides; and

one cam is arranged proximate each side of the second pair of opposing sides.

13. (Original) The substrate bonding device as claimed in claim 12, wherein the cams arranged proximate each side of the second pair of opposing sides are arranged substantially in the middle of each side of the second pair of opposing sides.

14. (Original) The substrate bonding device as claimed in claim 12, wherein the cams arranged proximate each side of the first pair of opposing sides are arranged at side portions of each side of the first pair of opposing sides.

15. (Original) The substrate bonding device as claimed in claim 12, wherein a distance between oppositely arranged ones of cams remains substantially constant upon being rotated.

16. (Original) The substrate bonding device as claimed in claim 1, further comprising interlocking means provided to the chamber units for coupling the upper chamber unit to the lower chamber unit.

17. (Original) The substrate bonding device as claimed in claim 16, wherein the interlocking means includes:

- a plurality of holes in the upper surface;
- a plurality of moveable shafts each having a first end and a second end; and
- a plurality of linear actuators fixed to the upper chamber unit and to the first ends of the plurality of moveable shafts for projecting the second ends of the plurality of the movable shafts into a corresponding one of the plurality of holes.

18. (Original) The substrate bonding device as claimed in claim 1, wherein the chamber moving means includes:

- a driving motor fixed to the base frame;
- a driving shaft coupled to the driving motor;
- a connecting part connected to the driving shaft;

a jack part connected to the upper chamber unit; and
a connecting shaft having one end connected to the upper chamber unit, and the other end connected to receive a driving force from the driving shaft.

19. (Original) The substrate bonding device as claimed in claim 1, further comprising a case for enclosing the upper and lower chamber units.

20. (Original) The substrate bonding device as claimed in claim 19, wherein a side portion of the case includes a first opening for loading substrates into the substrate bonding device.

21. (Currently Amended) The substrate bonding device as claimed in claim ~~[[19]]~~ 20, wherein a side portion of the case includes a second opening for unloading substrates into the substrate bonding device.

22. (Original) The substrate bonding device as claimed in claim 1, further comprising:
spraying means arranged at side portions of one of the upper and lower chamber units for spraying gas toward sides of the other one of the upper and lower chamber units;
blowing means for blowing the gas through the spraying means; and
a first flow tube having a first end in communication with the spraying means and a second end in communication with the blowing means.

23. (Original) The substrate bonding device as claimed in claim 22, wherein the spraying means includes a second flow tube arranged at side portions of the upper chamber unit, wherein a plurality of spraying holes are arranged at a bottom portion of the second flow tube.

24. (Original) The substrate bonding device as claimed in claim 23, wherein the spraying means further includes an ionizer for emitting ions.

25. (Original) The substrate bonding device as claimed in claim 24, wherein the ionizer includes an ion generating tip fitted in front of the plurality of spraying holes in the second flow tube.

26. (Original) The substrate bonding device as claimed in claim 22, further comprising an ionizer arranged proximate side portions of one of the upper and lower chamber units for emitting ions toward side portions of the other one of the upper and lower chamber units.

27. (Original) The substrate bonding device as claimed in claim 26, wherein the ionizer includes:

a flow tube arranged at side portions of the upper chamber unit, wherein the flow tube includes a plurality of spraying holes facing toward the upper and lower stages, wherein gas is flowable through the plurality of spraying holes; and

an ion generating tip arranged proximate a front portion of each of the plurality of spraying holes.

28. (Original) The substrate bonding device as claimed in claim 27, wherein the gas includes nitrogen gas.

29. (Original) The substrate bonding device as claimed in claim 27, wherein foreign material between the upper and lower chamber units is removable by the gas.

30. (Original) The substrate bonding device as claimed in claim 1, further comprising a sealing means provided to at least one of the upper and lower surfaces for sealing an interior space surrounding the first and second substrates, wherein the sealed interior space is definable by joined ones of the upper and lower chamber units.

31. (Original) The substrate bonding device as claimed in claim 30, wherein the sealing means includes an O-ring fitted along the upper surface.

32. (Original) The substrate bonding device as claimed in claim 1, further comprising:
first and second reels arranged at opposite side portions of at least one of the upper and lower stages;

a protection sheet for covering a surface of at least one stage, wherein the protection sheet is scrollable by the first and second reels; and

a rotating part for rotating the first and second reels.

33. (Original) The substrate bonding device as claimed in claim 32, wherein at least one of the upper and lower stages includes an electrostatic chuck for applying an electrostatic charge to secure a corresponding one of the first and second substrates.

34. (Withdrawn) The substrate bonding device as claimed in claim 33, wherein the electrostatic chuck includes polyimide.

35. (Original) The substrate bonding device as claimed in claim 33, wherein the electrostatic chuck includes a plurality of holes for transmitting a suction force to secure the corresponding one of the first and second substrates.

36. (Original) The substrate bonding device as claimed in claim 33, wherein the electrostatic charge applicable by the electrostatic chuck is transmittable by the protection sheet.

37. (Original) The substrate bonding device as claimed in claim 33, wherein the protection sheet includes a plurality of holes.

38. (Original) The substrate bonding device as claimed in claim 37, wherein the plurality of holes in the protection sheet are arrangeable to substantially correspond to a plurality of holes in the electrostatic chuck.

39. (Original) The substrate bonding device as claimed in claim 32, wherein the first and second reels are arranged elevationally lower than the surface of the lower stage.

40. (Withdrawn) The substrate bonding device as claimed in claim 32, wherein the first and second reels are arranged elevationally higher than the surface of the upper stage.

41. (Original) The substrate bonding device as claimed in claim 32, further comprising tension adjusting jigs arranged adjacent each of the first and second reels for maintaining the protection sheet to over the surface of the at least one stage to be substantially flat.

42. (Original) The substrate bonding device as claimed in claim 41, wherein the tension adjusting jigs are rotatably mounted.

43. (Original) The substrate bonding device as claimed in claim 41, wherein the tension adjusting jigs are movable in vertical directions.

44. (Original) The substrate bonding device as claimed in claim 41, wherein the tension adjusting jigs are movable in lateral directions.

45. (Original) A substrate bonding device for fabricating a liquid crystal display device (LCD), comprising:

a base frame;

a lower chamber unit mounted to the base frame, wherein the lower chamber unit defines a lower interior space and includes an upper surface;

an upper chamber unit arranged over the lower chamber unit, wherein the upper chamber unit defines an upper interior space, includes a lower surface, and is joinable to the lower chamber unit; chamber moving means for raising and lowering the upper chamber unit;

an upper stage arranged within the upper interior space for securing a first substrate;

a lower stage arranged within the lower interior space for securing a second substrate;

a sealing means provided to at least one of the upper and lower surfaces for sealing an interior space surrounding the first and second substrates, wherein the sealed interior space is definable by joined ones of the upper and lower chamber units; and

a case for enclosing the upper and lower chamber units.

46. (Original) The substrate bonding device as claimed in claim 45, wherein the case includes a transparent material, wherein an inside of the substrate bonding device is observable from outside the case through the transparent material.

47. (Currently Amended) The substrate bonding device as claimed in claim ~~[[45]]~~ 46, wherein the transparent material includes at least one window for enabling a portion of a substrate bonding process is observable from outside the case through the at least one window.

48. (Original) The substrate bonding device as claimed in claim 45, wherein an entirety of the case includes transparent material.

49. (Original) The substrate bonding device as claimed in claim 45, wherein the case includes a first opening for loading substrates into the substrate bonding device.

50. (Original) The substrate bonding device as claimed in claim 49, wherein the case includes a second opening for unloading substrates from the substrate bonding device.

51. (Original) The substrate bonding device as claimed in claim 50, wherein the first and second openings are formed in opposing surfaces of the case.

52. (Original) The substrate bonding device as claimed in claim 45, further comprising:
spraying means arranged at side portions of one of the upper and lower chamber units for spraying gas toward sides of the other one of the upper and lower chamber units;

blowing means for blowing the gas through the spraying means; and
a first flow tube having a first end in communication with the spraying means and a second end in communication with the blowing means for transporting the gas from the blowing means to the spraying means.

53. (Original) The substrate bonding device as claimed in claim 52, wherein the spraying means includes a second flow tube arranged at side portions of the upper chamber unit, wherein a plurality of spraying holes are arranged at a bottom portion of the second flow tube.

54. (Original) The substrate bonding device as claimed in claim 53, wherein the spraying means further includes an ionizer for emitting ions.

55. (Original) The substrate bonding device as claimed in claim 54, wherein the ionizer includes an ion generating tip fitted in front of the plurality of spraying holes in the second flow tube.

56. (Original) The substrate bonding device as claimed in claim 52, wherein a peripheral region of the other one of the upper and lower chamber units includes an outwardly sloped surface.

57. (Original) The substrate bonding device as claimed in claim 56, wherein the sloped surface is curved.

58. (Original) The substrate bonding device as claimed in claim 52, further comprising an ionizer arranged proximate side portions of one of the upper and lower chamber units for emitting ions toward side portions of the other one of the upper and lower chamber units.

59. (Original) The substrate bonding device as claimed in claim 58, wherein the ionizer includes:

a flow tube arranged at side portions of the upper chamber unit, wherein the flow tube includes a plurality of spraying holes facing toward the upper and lower stages, wherein gas is flowable through the plurality of spraying holes; and

an ion generating tip arranged proximate a front portion of each of the plurality of spraying holes.

60. (Original) The substrate bonding device as claimed in claim 59, wherein the gas includes nitrogen gas.

61. (Original) The substrate bonding device as claimed in claim 59, wherein foreign material between the upper and lower chamber units is removable by the gas.

62. (Original) The substrate bonding device as claimed in claim 45, further comprising:

first and second reels arranged at opposite side portions of at least one of the upper and lower stages;

a protection sheet for covering a surface of at least one stage, wherein the protection sheet is scrollable by the first and second reels; and

a rotating part for rotating the first and second reels.

63. (Original) The substrate bonding device as claimed in claim 62, wherein at least one of the upper and lower stages includes an electrostatic chuck for applying an electrostatic charge to secure a corresponding one of the first and second substrates.

64. (Withdrawn) The substrate bonding device as claimed in claim 63, wherein the electrostatic chuck includes a polyimide material.

65. (Original) The substrate bonding device as claimed in claim 63, wherein the electrostatic chuck includes a plurality of holes for transmitting a suction force to secure the corresponding one of the first and second substrates.

66. (Original) The substrate bonding device as claimed in claim 63, wherein the electrostatic charge applicable by the electrostatic chuck is transmittable by the protection sheet.

67. (Original) The substrate bonding device as claimed in claim 62, wherein the protection sheet includes a plurality of holes.

68. (Original) The substrate bonding device as claimed in claim 67, wherein the plurality of holes in the protection sheet are arrangeable to substantially correspond to a plurality of holes in the electrostatic chuck.

69. (Original) The substrate bonding device as claimed in claim 62, wherein the first and second reels are arranged elevationally lower than the surface of the lower stage.

70. (Withdrawn) The substrate bonding device as claimed in claim 62, wherein the first and second reels are arranged elevationally higher than the surface of the upper stage.

71. (Original) The substrate bonding device as claimed in claim 62, further comprising tension adjusting jigs arranged adjacent each of the first and second reels for maintaining the protection sheet to cover the surface of the at least one stage to be substantially flat.

72. (Original) The substrate bonding device as claimed in claim 71, wherein the tension adjusting jigs are rotatably mounted.

73. (Original) The substrate bonding device as claimed in claim 71, wherein the tension adjusting jigs are movable in vertical directions.

74. (Original) The substrate bonding device as claimed in claim 71, wherein the tension adjusting jigs are movable in lateral directions.

75. (Original) A substrate bonding device for fabricating a liquid crystal display device (LCD), comprising:

a base frame;

a lower chamber unit mounted to the base frame, wherein the lower chamber unit defines a lower interior space and includes an upper surface;

an upper chamber unit arranged over the lower chamber unit, wherein the upper chamber unit defines an upper interior space, includes a lower surface, and is joinable to the lower chamber unit;

chamber moving means for raising and lowering the upper chamber unit; an upper stage arranged within the upper interior space for securing a first substrate;

a lower stage arranged within the lower interior space for securing a second substrate;

spraying means arranged along side portions of one of the upper and lower chamber units for spraying gas toward side portions of the other one of the upper and lower chamber units;

blowing means for blowing the gas through the spraying means; and

a first flow tube having a first end in communication with the spraying means and a second end in communication with the blowing means.

76. (Original) The substrate bonding device as claimed in claim 75, wherein the spraying means includes a second flow tube arranged at side portions of the upper chamber unit, wherein a plurality of spraying holes are arranged at a bottom portion of the second flow tube.

77. (Original) The substrate bonding device as claimed in claim 76, wherein the spraying means further includes an ionizer for emitting ions.

78. (Original) The substrate bonding device as claimed in claim 77, wherein the ionizer includes an ion generating tip fitted in front of the plurality of spraying holes in the second flow tube.

79. (Original) The substrate bonding device as claimed in claim 75, wherein a peripheral region of the other one of the upper and lower chamber units includes an outwardly sloped surface.

80. (Original) The substrate bonding device as claimed in claim 79, wherein the sloped surface is curved.

81. (Original) The substrate bonding device as claimed in claim 75, further comprising an ionizer arranged proximate side portions of one of the upper and lower chamber units for emitting ions toward side portions of the other one of the upper and lower chamber units.

82. (Original) The substrate bonding device as claimed in claim 81, wherein the ionizer includes:

a flow tube arranged at side portions of the upper chamber unit, wherein the flow tube includes a plurality of spraying holes facing toward the upper and lower stages, wherein gas is flowable through the plurality of spraying holes; and

an ion generating tip arranged proximate a front portion of each of the plurality of spraying holes.

83. (Original) The substrate bonding device as claimed in claim 82, wherein the gas includes nitrogen gas.

84. (Original) The substrate bonding device as claimed in claim 82, wherein foreign material between the upper and lower chamber units is removable by the gas.

85. (Original) The substrate bonding device as claimed in claim 75, further comprising:
first and second reels arranged at opposite side portions of at least one of the upper and lower stages;
a protection sheet for covering a surface of at least one stage, wherein the protection sheet is scrollable by the first and second reels; and
a rotating part for rotating the first and second reels.
86. (Original) The substrate bonding device as claimed in claim 85, wherein at least one of the upper and lower stages includes an electrostatic chuck for applying an electrostatic charge to secure a corresponding one of the first and second substrates.
87. (Withdrawn) The substrate bonding device as claimed in claim 86, wherein the electrostatic chuck includes a polyimide material.
88. (Original) The substrate bonding device as claimed in claim 86, wherein the electrostatic chuck includes a plurality of holes for transmitting a suction force to secure the corresponding one of the first and second substrates.
89. (Original) The substrate bonding device as claimed in claim 86, wherein the electrostatic charge applicable by the electrostatic chuck is transmittable by the protection sheet.
90. (Original) The substrate bonding device as claimed in claim 86, wherein the protection sheet includes a plurality of holes.

91. (Original) The substrate bonding device as claimed in claim 90, wherein the plurality of holes in the protection sheet are arrangeable to substantially correspond to a plurality of holes in the electrostatic chuck.

92. (Original) The substrate bonding device as claimed in claim 85, wherein the first and second reels are arranged elevationally lower than the surface of the lower stage.

93. (Withdrawn) The substrate bonding device as claimed in claim 85, wherein the first and second reels are arranged elevationally higher than the surface of the upper stage.

94. (Original) The substrate bonding device as claimed in claim 85, further comprising tension adjusting jigs arranged adjacent each of the first and second reels for maintaining the protection sheet to over the surface of the at least one stage to be substantially flat.

95. (Original) The substrate bonding device as claimed in claim 94, wherein the tension adjusting jigs are rotatably mounted.

96. (Original) The substrate bonding device as claimed in claim 94, wherein the tension adjusting jigs are movable in vertical directions.

97. (Original) The substrate bonding device as claimed in claim 94, wherein the tension adjusting jigs are movable in lateral directions.

98. (Currently Amended) A substrate bonding device for fabricating a liquid crystal display (LCD) device, comprising:

an upper stage for securing a first substrate of an LCD device;

a lower stage for securing a second substrate of the LCD device;

first and second reels arranged at opposite side portions of at least one of the upper and lower stages;

a protection sheet for substantially covering a surface of at least one stage, wherein the protection sheet is scrollable by the first and second reels; and

a rotating part for rotating the first and second reels.

99. (Original) The substrate bonding device as claimed in claim 98, wherein at least one of the upper and lower stages includes an electrostatic chuck for applying an electrostatic charge to secure a corresponding one of the first and second substrates.

100. (Withdrawn) The substrate bonding device as claimed in claim 99, wherein the electrostatic chuck includes a polyimide material.

101. (Original) The substrate bonding device as claimed in claim 99, wherein the electrostatic chuck includes a plurality of holes for transmitting a suction force to secure the corresponding one of the first and second substrates.

102. (Original) The substrate bonding device as claimed in claim 99, wherein the electrostatic charge applicable by the electrostatic chuck is transmittable by the protection sheet.

103. (Original) The substrate bonding device as claimed in claim 99, wherein the protection sheet includes a plurality of holes.

104. (Original) The substrate bonding device as claimed in claim 103, wherein the plurality of holes in the protection sheet are arrangeable to substantially correspond to a plurality of holes in the electrostatic chuck.

105. (Original) The substrate bonding device as claimed in claim 98, wherein the first and second reels are arranged elevationally lower than the surface of the lower stage.

106. (Withdrawn) The substrate bonding device as claimed in claim 98, wherein the first and second reels are arranged elevationally higher than the surface of the upper stage.

107. (Original) The substrate bonding device as claimed in claim 98, further comprising tension adjusting jigs arranged adjacent each of the first and second reels for maintaining the protection sheet to over the surface of the at least one stage to be substantially flat.

108. (Original) The substrate bonding device as claimed in claim 107, wherein the tension adjusting jigs are rotatably mounted.

109. (Original) The substrate bonding device as claimed in claim 107, wherein the tension adjusting jigs are movable in vertical directions.

110. (Original) The substrate bonding device as claimed in claim 107, wherein the tension adjusting jigs are movable in lateral directions.

111. (Withdrawn) A method of protecting stages of a substrate bonding device for fabricating a liquid crystal display (LCD) device, comprising:

providing a stage for securing a substrate of an LCD device;

providing first and second reels on opposite sides of the stage;

arranging a protection sheet over a surface of the stage, the protection sheet being scrollable over the surface of the stage;

determining whether the protection sheet needs to be replaced; and

based on the determining, rotating first and second reels such that the protection sheet over the surface of the stage is wound around one of the first and second reels and a new protection sheet is unwound from the other of the first and second reels and is arranged over the surface of the stage.

112. (Withdrawn) The method as claimed in claim 111, wherein determining whether the protection sheet needs to be replaced includes determining whether a number of substrates bonded using the protection sheet exceeds a predetermined number of substrate bonding processes.

113. (Withdrawn) The method as claimed in claim 111, wherein determining whether the protection sheet needs to be replaced includes determining whether a predetermined amount of time has elapsed.

114. (New) The substrate bonding device as claimed in claim 1, wherein the alignment means is arranged outside the lower interior space.

115. (New) The substrate bonding device as claimed in claim 32, wherein the first and second reels are arranged within at least one of the lower and upper interior spaces.

116. (New) The substrate bonding device as claimed in claim 62, wherein the first and second reels are arranged within at least one of the lower and upper interior spaces.

117. (New) The substrate bonding device as claimed in claim 85, wherein the first and second reels are arranged within at least one of the lower and upper interior spaces.

118. (New) The substrate bonding device as claimed in claim 98, further comprising:

a lower chamber unit, wherein the lower chamber unit defines a lower interior space within which the lower stage is arranged; and

an upper chamber unit over the lower chamber unit, wherein the upper chamber unit defines an upper interior space within which the upper stage is arranged,

wherein the first and second reels are arranged within at least one of the lower and upper interior spaces.